

Fire Protection and Safety Design Guide

• Introduction

The Appendix “A” defines the scope of A&E services. This Fire Protection and Safety Design Guide further defines the fire protection and safety services identified in the Appendix “A” and identifies our technical and submittal requirements for fire protection and safety engineers doing design work for the Atlantic Division.

• Communications

Direct communication with the LANTOPS fire protection reviewer is encouraged. If you have a question concerning a particular comment, contact your LANTOPS reviewer. This may avoid unnecessary re-submittal of plans and specifications due to a misunderstood comment. The reviewer’s name, phone number and E-mail address can be found on the comment sheet.

• Fire Protection and Safety Design Requirements

This section identifies the requirements and expectations for different aspects of the fire protection and system safety design process. Frequent reference is made to various design documents, criteria and other sources of information throughout this document. Hyperlinks to the Internet home pages of these sources have been provided for the user’s convenience and are located within this document and in the “References” section at the end of this document.

• Water Supply

• Water Distribution Systems

- Do not locate any fire mains under buildings.
- Consider provision of looped mains with adequate sectionalizing valves for facilities of significant value or mission criticality.
- Avoid operating buried mains at high pressure (over 100 psi) whenever possible. Incorporate surge protection on all installations where fire pumps feed buried mains.
- Do not provide fire hydrants on buried mains supplied by fire booster pumps.
- Minimum size for a fire main shall be 6 inches in diameter. Conservatively size mains on the combined demands of domestic and fire protection systems as reflected in the preliminary calculations.
- Specify backflow prevention for all sprinkler systems supplied by potable water systems. Typically double check valve assemblies will suffice. However, some activities or host states/countries may require reduce pressure type backflow prevention. Concurrence on the final type will have to be sought from the activity environmental office. Locate the backflow preventer in the sprinkler riser room.

• Fire Pumps

Type

- Electric motors are the preferred driver for the fire pumps. See [MIL-HDBK-1008](#) for criteria to ascertain “reliability” of commercial power. If commercial power cannot meet reliability requirements, an electric pump with secondary power from an on-site generator is preferred. Following this, an electric pump backed up by a diesel engine driven pump is the next preferred alternative. The least preferred

arrangement is a single engine driven pump (due to high maintenance requirements and overall lack of long term reliability in the absence of necessary maintenance).

- For diesel engine driven pumps insure that electric circuits are provided for both the pump controller and the engine block heater

Horizontal Split-Case

- Do not use horizontal tee and elbow fittings on the suction side of pumps. Refer to NFPA 20 for guidance.
- Provide a circulation relief valve and bowl drains piped independently to a closed drain. NFPA 20 no longer permits recirculation of relief valve discharge to suction piping.

Controllers/Hydraulic Surge Control

- Electric driven Pumps: Use reduced voltage, solid state soft, starting controllers when supplied from a generator, when electric booster pump net pressure ratings exceed 50 psi, when electric fire pump net pressure exceeds 80 psi, when pump discharge pressures approach 175 psi, or when pump discharge piping runs underground.
- Engine Driven Pumps: Provide surge arresting bladder tanks for the above conditions.
- Every pump controller shall be supervised for pump operating and pump trouble conditions by the building fire alarm system. Both conditions shall transmit independently as a supervisory condition.
- Provide an exterior grade 10 inch weather proof trouble bell which sounds for both pump running and pump trouble conditions when the base fire reporting system is not capable of transmitting trouble or supervisory conditions.
- Jockey pumps should not be supervised.

Location

- Provide amply sized pump rooms to allow access and maintenance of all equipment.
- Engines and controllers should not be exposed to exterior conditions, and must be protected from freezing conditions.

Design

- Pump sizing shall be based on accurate preliminary hydraulic calculations.
- Limit pump net pressures to the minimum necessary to minimize extreme operating pressures on the entire system.
- Maximum sprinkler demand and interior standpipe demands will not exceed 120% of pump capacity.
- Do not add the exterior hose allowance to the system demand to determine the size of the booster pump.
- Insure the suction supply can meet 150% of the pump's rated capacity.

Power Supply

Follow Chapters 7 and 8 of NFPA 20 explicitly concerning power transfer for alternate power supply. Also refer to Appendix A of NFPA 20.

Testing

Convenient, easy to use, flow testing facilities encourage frequent performance testing of pumps, thereby increasing reliability of the overall system. Incorporate the following into all pump installations:

- Locate and orient a straight-line style test header manifold on building exterior that permits flow testing directly from header without laying hose. Attention should be given to management of water discharged during the testing.
 - Locate a flow meter such that both the test loop and the test header arrangement are metered. This provides a means to periodically check flow meter accuracy. Valve downstream of the meter shall be a globe valve.
 - Where pumps exceed 1250 gpm or at remote locations, specify that the contractor is to provide a sufficient number of Underwriters play –pipes with 1 ¾ inch outlets for periodic testing.
- **Water Storage Tanks**
 - Specify compliance with NFPA 22.
 - Preference is for welded tanks versus bolted.
 - Include cathodic protection, water level indicator, low-level supervisory switch and low temperature supervision (where applicable).
 - Discharge lines from flow meters and pressure relief valves and fill line shall return to the tank over the top. Provide a positive air gap.
 - Note that tank capacity of that portion of the tank that is below the centerline of the fire pumps(s) is unusable and shall not be considered as available capacity.
- **Fire Suppression Systems**
 - **Water Based Sprinkler Systems**
 - Provide concrete splash blocks at main drain and inspector test connection discharge locations.
 - For multi-story buildings where individual floor isolation valves are provided, locate the inspector's test connections at the remote area of the systems instead at floor control valve locations. Locate additional isolation valves and drains (express piping system to grade) at each respective floor connection as required.
 - Identify the thrust block, restraining rods, and pipe sleeve on the sprinkler riser detail.
 - Backflow prevention is required for every sprinkler system supplied by potable water systems. Locate in the building at the sprinkler riser. Do not locate outside if freeze protection is necessary. Heat trace is not acceptable. Systems utilizing AFFF shall be provided with reduced pressure principle backflow prevention.
 - If valve tamper switches (with tamper proof covers) are required, they shall be provided for all sprinkler system control valves, including post indicator valves and isolation valves on backflow preventers.
 - Edit the guide specs in the piping sections to permit steel piping with a UL corrosive resistive rating (CRR) of not less than 1.00.
 - Edit the guide specs to permit the use of butterfly valves.
 - If specs identify painting of sprinkler piping in unfinished or concealed spaces, omit the requirement for painting. Edit the specs to require red identification bands for sprinkler piping in unfinished or concealed spaces.
 - Specify painting of ferrous steel piping/fittings or use of galvanized piping when systems are installed in humid, salt air, or corrosive environments, or when specifically requested by the customer.

- **Wet Pipe Systems**

- First system choice for simple, reliable property protection.
- Utilize conservative densities and design areas as given in [MIL-HDBK-1008](#).
- Utilize new technology (quick response (QR), early suppression fast response (ESFR) sprinklers, etc.) where appropriate. Utilize quick response sprinklers in all facilities with childcare, berthing, non-ambulatory patients, light hazard occupancies, and where beneficial.
- FM approved CPVC pipe and fittings may be allowed in NFPA 13R retrofit applications and NFPA 13D systems only. Plastic piping shall not be installed exposed as allowed by UL listings.

- **Dry Pipe Systems**

- NFPA 13 has limitations on volumetric capacities of dry pipe systems. Generally, as the coverage area of a single dry pipe system approaches 15,000 square feet, the overall capacity of the system may approach this limit.
- Avoid manifold risers in large warehouses to prevent delivery time problems.
- Monitor high and low air pressure on a per riser basis as a supervisory function with the building fire alarm system. "Shop air" and compressed gas cylinders are not acceptable sources of pressurized air.

- **Preaction/Deluge Systems**

- Utilize only where absolutely required.
- Actuate with electric heat detectors in dirty, damp, exterior areas, or spaces with fluctuating temperatures. Do not actuate with smoke detection, except in child development centers.
- Specify bracing for seismic zone 3, regardless of location, to provide thrust restraint of piping for deluge systems.
- Generally, provide a preaction/deluge releasing panel independent of the building fire alarm system panel. Locate the releasing panel either adjacent to the preaction sprinkler risers or adjacent to the building fire alarm panel. The building fire alarm panel shall supervise the releasing panel for common alarm and trouble conditions. Where more than four preaction systems are controlled by one releasing panel and the releasing panel is physically separated from the building fire alarm panel, the fire alarm panel shall supervise each preaction system as a separate zone for alarm conditions in addition to a common releasing panel trouble condition.
- If the preaction system initiating devices comprise 75% or more of the entire facility alarm initiating devices, a combined preaction releasing/building fire alarm system panel may be considered.

- **Standpipe**

- Provide where required and when requested by a base.
- Specify a Class I type system. Do not design a class II or III system.
- Follow NFPA 14 with exception that many installations can use a 65-psi outlet discharge pressure. Consult LANTDIV Code C148 for specific guidance in this area.

- **Foam/Water Based – Aqueous Film Forming Foam (AFFF)**
 - **Low Expansion Foam**
 - Suitable primarily for flammable liquids fire control (aircraft hangars, flammable liquid storage/handling facilities).
 - Maintain design as simple as possible. Bladder tank systems are preferred over pump/skid systems when economically feasible (Navy & Marine Corps) to eliminate concentrate pumps and pressure balancing valves.
 - Horizontal bladder tanks are preferred to vertical tanks based on decreased susceptibility of bladder tearing occurring during improper filling procedures. Vertical tanks should not be used on new installations. Locate tanks so that bladders can be replaced with tank in place.
 - Plans and specifications development requires a high degree of expertise for a clean, well functioning installation. Most A&E firms should contract design out to a specialty Fire Protection engineering Consulting Firm.
 - Provide foam concentrate jockey pumps where foam concentrate lines to the injection points are run either underground or where they run above ground for more than 50 feet.
 - Design with close communication links with LANTDIV Code CI48.
 - Provide means to flow test proportioner(s) through a closed loop into a tanker truck for test solution management.
 - On wet systems, provide means to conveniently drain system into 55-gallon drums (i.e., drain connections terminating 5 feet above finished floor with hose connections in locations accessible to fork lift trucks).
 - Designs that eliminate normally closed concentrate control valves are preferred.
 - Coordinate with LANTDIV Code CI48 for retention/run-off requirements. Permits may be required.
 - **High Expansion Foam**
 - Suitable for flammable liquids protection where control of runoff is of major importance. Typically cannot be used for protection of polar solvents.
 - Installations are costly to build and challenging to maintain. Keep the design as simple as possible.
 - Plans and specifications development requires a high degree of expertise for a clean, well functioning installation. Most A&E firms should contract design services out to a specialty Fire protection Engineering Consulting Firm.
 - Installations will typically require a small capacity booster pump due to the high pressure requirements of the foam generators. Provide surge management of pressures.
 - A full discharge test is required for determining system acceptance.
- **Gaseous**
 - **Carbon Dioxide (CO₂) Extinguishing Systems**
 - A common releasing panel may control multiple systems. The releasing panel shall be separate from the building fire alarm panel, unless approved by LANTDIV Code CI48. The releasing panel shall be electrically supervised for common trouble and alarm conditions at the building fire alarm panel.
 - Provide interlocks to shut down all computer equipment power and associated room air conditioner power prior to agent discharge.

- Provide separate storage bottles/manifold for each hazard. Do not design multiple hazard protection using a selector valve and a common manifold.
 - Do not identify quantities of CO₂ on the contract drawings. Only show all information contractors need to calculate the necessary quantities.
 - Ensure adequate space is available for the CO₂ storage cylinders and the floor can structurally support the weight.
 - Consider using low pressure systems when appropriate and cost effective.
 - Inhibit switches are not permitted per NFPA 12.
 - Show all necessary interconnections/interlocks on respective mechanical, electrical, and/or fire protection sheets.
 - Provide an under-the-floor purge system to evacuate the CO₂ after testing and/or discharge.
 - Specify that the storage bottle manifold be provided with scales for weighing cylinders.
 - Pre-discharge alarms shall have different audible sounds than the building fire alarm system.
- **Halon Extinguishing Systems**
 - The use of halon, or any other ozone depleting substances, is strictly prohibited for any new construction projects.
 - Projects involving the demolition of existing Halon 1301 fire extinguishing systems shall include the removal, and shipping of the storage cylinders to the Defense Depot in Richmond, Virginia. The construction contract shall include securing, packing and shipping of the cylinders to the Defense Depot.
- **Halon Replacement Gases**
 - Utilize only where justified.
 - Agent must have EPA SNAP list (<http://www.epa.gov/spdpublic/title6/snap/lists/index.html>) and UL listing or FM approval.
 - Design in accordance with products listing and NFPA 2001.
 - Obtain LANTDIV Code CI48 concurrence prior to design development.
- **Wet Chemical Extinguishing System**
 - Specify wet chemical systems for protection of commercial grade cooking equipment. If the commercial grade equipment is equipped with an internal wash down system, please indicate this on the plans.
 - System activation shall be supervised by the building fire alarm panel as a separate zone.
 - Identify interlocks to cooking surface fuel/power supplies when automatic shutdown. Ensure coordination with the appropriate mechanical and electrical drawings.
 - Properly show the designed location of the main manual activation station.
- **Residential Grade Kitchen Hood Extinguishing System**

These types of devices are strongly discouraged, especially in units provided with sprinkler systems. When specifically requested by the customer and approved by the LANTDIV Fire Protection Engineering Branch, Code CI48, each system shall consist of a pre-assembled extinguisher kit, piping kit, and detection kit to be installed in the kitchen cabinet over the range hood and stove. The system shall automatically detect and extinguish stovetop fires, shut off the cooking appliance, and sound an alarm.

Detection shall be by means of reusable bi-metallic thermal links. Provide one thermal link over each burner. Each wet chemical system shall be provided with no less than 2.5 pounds of a solution of water-based chemical or a combination thereof, which forms an extinguishing agent. Wet nozzles shall be of corrosion resistant material. Wet system nozzles shall provide complete coverage of the entire cooking surface. The automatic alarm shall provide complete coverage of the entire cooking surface. The automatic alarm shall sound an 85-dBa alarm signal when activated. Provide internal wiring required for the system to be complete and ready for use. The automatic wet chemical fire extinguisher system shall, as a system, have a current UL label and UL listing.

- **Fire Alarm/Detection**

- **Building Fire Alarm Systems**

- Control Panel Functions

- Smoke detector verification shall be specified for detection systems that may be subjected to monetary environmental changes that may cause nuisance alarms. Detector verification shall only be used for smoke detectors and shall not be used for detectors controlling automatic fire suppression systems, duct detectors, or detectors used for elevator recall.
 - Conventionally zoned initiating circuits shall be specified on smaller less complex systems. Point addressable initiating circuits should be considered for larger, complex systems or systems that point annunciation is desirable or required. Consult LANTDIV Code CI48 towards preferences regarding conventional or addressable systems.
 - Branch circuit surge suppressers shall be specified for fire alarm AC power sources.
 - Control panel battery capacity shall be 24 hours standby capacity and 30 minutes alarm for fire alarm panels provided with auxiliary power supplied from an emergency generator. Battery capacity shall be 60 hours standby capacity and 30 minutes alarm for all other systems. Deviations from these requirements shall be confirmed with the LANTDIV Code CI48 Fire Protection Engineering Branch.
 - The location of the fire alarm panel shall be coordinated with the local fire department and the user. Locate the control panel in a conditioned space within the building. If the control panel cannot be located in plain view at the fire departments emergency point of entry, a remote annunciator shall be placed at that location. The zoning of the remote annunciator shall duplicate the fire alarm control panel zoning with a common trouble indicator light and a key operated audible trouble indication. The panel shall also be provided with a key-operated alarm silence switch, when activated will silence all building alarms. Panels located in finish spaces shall not be aesthetically obtrusive. Provide a smoke detector in the vicinity of the control panel as required by NFPA 72.
 - VAC power for fire protection equipment shall be obtained from a dedicated circuit breaker equipped with a "lock-on" device that must be removed before the breaker can be de-energized. The face of the breaker shall be painted red.
 - The building fire alarm system shall be configured to report to the central dispatch point via the base wide fire reporting system. The appropriate radio transmitter/coded master box/telephone interface shall be provided.
 - Do not specify a remote trouble bell for fire alarm systems monitored by base reporting system capable of reporting general alarm and trouble signals to the base fire department.
 - When the base fire reporting system is not capable of transmitting trouble conditions, and when the fire alarm panel is not located in an area not normally

occupied where the internal trouble sounder may not be heard, a remote trouble indication shall be specified.

- The building alarm system shall monitor all manual stations, automatic detection, sprinkler flow and supervisory devices, local releasing functions, and fire pump running and supervisory functions.
- Auxiliary functions requiring an interface with line voltage sources shall be accomplished by field located relays. The only line voltage permitted in fire alarm or releasing panels is operating power.
- Consider tasking the contractor with layout of notification devices per NFPA 72 and ADA. Specify that acceptance will be based on measuring satisfactory sound levels with a sound meter in all spaces with normal ambient noise and provisions of indicating devices per ADA. Expected ambient noise levels must be identified in the contract documents.

Initiating Devices

- Specify dual action manual pull stations in areas where the manual stations are subject to false activation from mechanical jarring.
- Smoke detection shall be provided for computer room under floor spaces. Underfloor detectors shall be equipped with a graphic annunciator panel showing detector location with respect to the floor plan.
- Smoke detection shall be used in areas requiring detection except in areas which are subjected to dust infiltration or steam (i.e., attics, mechanical rooms, etc.). Heat detection shall be specified for these areas.
- Combination rate-of-rise/fixed temperature heat detectors shall be used in areas where rapid temperature swings are not expected. Specify fixed temperature heat detectors where rapid temperature swings are expected (i.e., over ovens, fuel fired equipment, etc.). The temperature rating of the fixed temperature elements shall be based on the maximum ambient temperature expected in conjunction with the manufacturer's recommendations.
- Place duct type and spot type smoke detection on dedicated zones. Do not combine spot type smoke detectors on initiating zones with duct smoke detectors or contact type initiating devices. Duct smoke detectors shall not be on a verified circuit. Activation of a duct smoke detector shall cause shutdown of the air handling unit(s) and initiation of an alarm condition.
- Provide each duct smoke detector with the detector manufacturer's remote indicator/test station located in an accessible area. Utilize photoelectric detectors only.
- When placing multiple duct smoke detectors on one zone, the wiring method shall be a four-wire arrangement.
- Limit valve tamper switches to a maximum of three devices per any one zone. Tamper switches shall not be on a zone with any flow or pressure switches. Follow NFPA 72 direction.
- Provide a smoke detector at the fire alarm panel and at any fire alarm sub-panel to meet NFPA 72 requirements.

Signaling Devices

- Combination audio/visual units shall be specified for indicating circuits except where visual only units supplement audio/visual units or are specifically required by ADA, i.e., rest rooms.
- Visual unit's candela output and frequency shall meet both NFPA and ADA requirements.
- Identify the candela strobe requirement on the floor plans.
- Flashing visual units shall be synchronized with each other throughout the evacuation area for all occupancies.
- Signal circuits shall be wired Style Z (Class A).

- Visual circuits shall be separate from audible device circuits. Visual devices shall not be affected by operation of the alarm panel signal silence switch.
- **Residential Systems**
 - 120 VAC, single station smoke detectors shall be provided. Detectors shall be interconnected with other detectors in the same living unit such that activation of any detector shall cause all detectors within that unit to sound.
- **Fire Extinguishing Agent Releasing Panels**
 - A control panel listed for releasing service shall be specified for monitoring, and operation of automatic extinguishing systems.
 - All initiating circuits shall be Style D (Class A).
- **Elevators**

NOTE: The NAVFAC Elevator Policy is currently in the process of being rewritten. Contact the LANTDIV Fire Protection Office for information.

Fire Resistance of Machine Room and Shaft

- All elevator shafts and machine rooms shall be 2-hour fire rated regardless of the building height or elevator travel distance.
- All openings in the elevator shaft or machine room shall be protected with 90 minute rated doors.

Sprinklers and Flow Switches

- Provide sprinklers in the pit and machine room of all hydraulic elevators spaced in accordance with NFPA 13.
- Only provide sprinklers at the top of the elevator hoistway/shaft if hydraulic lines run above the elevator car.
- Provide a sprinkler flow switch, check valve, control valve, and test drain/connection for each separate elevator area covered by sprinklers. (i.e. provide a separate test assembly (connected to an express drain to the exterior) for the sprinkler in the pit, machine room and top of hoistway if provided). This will allow for testing of each flow switch independently. Flow switches must contain two sets of contacts and activate instantly upon water flow. All flow switches must be tied to the elevator controllers for shunt trip of elevator power and to the fire alarm control panel for fire alarm activation. One zone on the fire alarm system will suffice for all elevator flow switches. Locate all elevator sprinkler assemblies in a convenient location outside of the associated protected area.

Heat Detectors

- Provide a heat detector adjacent to **each** sprinkler head protecting the elevator pit, machine room and/or hoistway. These heat detectors should be tied to the warning sign in the elevator car only, not the fire alarm control panel.

Smoke Detectors

- Provide smoke detectors, spaced in accordance with NFPA 72, in the elevator machine room, each elevator lobby, and, if a sprinkler is provided in the pit, hoistway, or both, at the top of the hoistway.

- Smoke detectors should be fire alarm system smoke detectors provided with a means to recall the elevator. NFPA 72 does not specify that elevator recall be initiated via contacts in the back of each detector but this would be the preferred method if at all possible.

Elevators Outside the United States

- For elevators outside the U. S., eliminate the sprinkler heads and heat detectors in the elevator machine room, pit and or hoistway. Since no sprinklers are provided in the hoistway or pit, there is no need for a smoke detector in the hoistway.
- Please ensure that the walls around the elevator shaft and machine rooms are provided with 2-hour fire rated walls and 90-minute fire rated doors as a minimum.

• **Pre-Design Services**

• **Fire Protection Field Investigation**

- Life Safety/Building Code Survey when existing facilities are involved.
- Site Survey to obtain information regarding exterior fire alarm reporting system.
- Water Flow Testing of Fire Hydrants to obtain available static and residual water pressure and water volume for the project location.

• **Design Services**

• **Fire Protection Basis of Design**

Fire Protection Engineering Design Analysis

The following represents LANTDIV's requirements for the Fire Protection Design Analysis portion of a submittal. This portion is critical to the understanding of the designers intent and methodology of design. Although our contract documents relating to active fire protection systems are typically prepared as performance specifications, certain preliminary design information is critical to ensure the final documents prepared will be biddable. The following is a guide to the minimum design analyses required at the earliest possible stage in design, but no later than the 35% stage.

Fire and Building Code Analysis

The A&E should utilize all NFPA Codes, the latest version of [MIL-HDBK-1008](#), and the appropriate Building Code in their design. NFPA 101, the Life Safety Code (LSC), is the primary code to which fire protection engineering adheres. Fire Protection life safety features are supplemented by use of the Uniform Building Code (UBC), published by the International Conference of Building Officials located in Whittier, California. The UBC shall be used primarily to determine allowable building construction sizes for the specific occupancy and construction type (Table 5B). The UBC shall also be used to address other building code criteria not covered by NFPA standards (i.e., building separation requirements, minimum construction standards, etc.).

Life Safety Analysis

Provide an analysis that identifies the following:

- Building occupancy classification per the UBC
- Building construction type per the UBC

- Facility square footage (per floor & total) proposed and maximum permitted by the UBC
- Identify required and provided separation distances from existing and planned facilities per the UBC
- Interior fire and/or smoke rated wall/partition requirements
- Fire rating of each floor, ceiling system, roofing system when applicable
- Occupancy classification per the LSC
- Maximum permitted travel distances, common path of travel, dead end corridor lengths
- Required and provided egress capacity calculations
- Identify type(s) of fixed detection/fire alarm/suppression systems to be provided.

- **System Safety Basis of Design**

System Safety Design Analysis

A system safety review is required for all projects and shall be indicated by providing the following minimum information.

- Past Experience: Summarize typical safety concerns and employee accident potential for projects of the contract type.
- OSHA Standards: Summarize design features and safeguards provided for this project, (i.e., eyewash/showers, ladder safety cages, barriers, guardrails, etc.) that will be included specifically to comply with [OSHA 1910](#), (general Industry Standards), and other applicable [OSHA Codes](#).
- Special Hazards: List major potential safety and health hazards, proposed engineering controls, and safeguards for the protection of operators, users, visitors, and maintenance personnel. Refer to [LANTDIV Form 5100/12](#), "Preliminary Hazard List and Risk Assessment Code Validation Sheet", when available.
- Extended Preliminary Hazard List: If LANTDIV has include a list of potential safety hazards as part of the A&E Scope of Work, indicate the name of the A&E representative responsible for review of and response to each identified hazard, indicating how the hazard was eliminated, controlled, or addressed.
- Construction Hazards: Indicate proposed design features that will allow safe access to equipment where periodic access by maintenance workers will be required.
- Maintenance Considerations: Identify design features that will allow safe access to equipment where periodic access by maintenance workers will be required.
- MIL-STD-882: Identify any planned or completed [MIL-STD-882](#) safety analyses for this project.

- **Fire Protection Calculations**

Hydraulic Analysis

The design analysis shall calculate the "*anticipated*" water demand of a facility to establish the minimum water supply required for the project.

Sprinkled Buildings

New Buildings

- All facilities requiring sprinkler systems and exceeding 3000 square feet shall be hydraulically designed. Utilize the Hydraulic Demand Analysis Worksheet included as Attachment A. Refer to the latest edition of [MIL-HDBK-1008](#) for hazard classifications and design criteria determination. Pipe schedule systems, if utilized, first must be approved by the LANTDIV Fire Protection Engineer assigned to the project. Once approved, these systems shall comply with NFPA 13 for the appropriate hazard as identified in [MIL-HDBK-1008](#).

Existing Buildings

- Establish if the existing sprinkler system is hydraulically designed or piped scheduled. Information on an existing system may be obtained from the base fire department, public works department, or from the LANTDIV Fire Protection Office, if records exist.
- *Hydraulically Designed Systems.* Indicate the size and location of all feed main and cross main piping from the point of connection to the existing system back to the sprinkler riser. All grid branch line piping must be indicated for existing gridded systems. Identify the available water supply at the base of the riser. Do not assume that the available water supply will be that identified with the existing design. Obtain current information. Utilize the Hydraulic Demand Analysis Worksheet included as Attachment A.
- *Pipe Schedule Systems.* Determine the hazard classification and whether the existing cross and feed mains, and the riser pipe sizes can support the new piping and sprinkler heads per NFPA 13. Identify the size of the pipe at the point of connection. Identify all existing piping requiring replacement.

Non-Sprinkled Buildings

Water demands for non-sprinkled buildings are identified in [MIL-HDBK-1008](#).

Hydraulic Supply Analysis

Evaluating the available water supply is critical for both sprinklered and unsprinklered buildings. Documents cannot be released for advertisement with expectations of the contractor determining the available water supply. LANTDIV Fire Protection Engineering needs to be certain that the available water supply can support the specified demand of a sprinkler system **prior to advertisement**. The A&E is responsible for obtaining water distribution maps, establishing flow testing procedures and coordinating flow testing with the base fire department and public works. It is not the responsibility of the LANTDIV Fire Protection Engineering Office to perform these functions for the A&E. Flow testing responsibilities belong to the A&E. Flow testing may be conducted by base personnel and witnessed by the A&E if this is preferred by base personnel. The A&E shall be responsible for conducting the actual flow testing for facilities that are not on federal government property. Flow tests shall be conducted to establish the static pressure and available water flow at a residual pressure. The A&E shall graph the results for comparison with the anticipated hydraulic demand. This analysis is required for both sprinkled **and non-sprinkled** facilities.

Existing Water Distribution Systems

If the existing base water distribution system or dedicated fire main includes existing fire booster pumps, flow tests must be conducted in the vicinity of construction with a sufficient number of fire pumps running to ensure the available water supply will support the anticipated hydraulic demand. If, at the time of design, the fire booster pumps cannot be run and accurate flow testing cannot be conducted, the following information must be included in the contract documents:

- All water distribution piping back to the fire booster pumps. Show the location of water supplies such as elevated water storage tanks.

- Make, model rated characteristics of each fire booster pump and the number of booster pumps expected to be operating based on the anticipated hydraulic demand.
- Available water supply (flow test data) at the suction side of the booster pumps(s).

Evaluation of Hydraulic Supply versus Demand

Plot the available water supply versus the hydraulic demand on $Q^{1.85}$ hydraulic graph paper. The National Fire Protection Association ([NFPA](#)) and Society of Fire Protection Engineers ([SFPE](#)) handbooks provide guidance for determination and selection of fire booster pumps and supplementary water supplies. If the evaluation determines that a booster pump or supplemental water supply is required, provide appropriate supporting calculations.

Fire Pumps

Provide the following calculations verifying fire pump selection:

- Calculations supporting selected rated fire pump capacity and pressure.
- Power calculations for motor driven pumps.
- Fuel supply calculations for engine driven pumps.
- For electric motor driven pumps provide fault current analysis calculations at the fire pump controller to establish equipment withstand ratings.
- When applicable, provide calculations for the suction supply water tank.
- Provide surge analysis of the entire system.

Special Systems

AFFF Extinguishing Systems

- Provide a statement identifying the intended design. Identify the type of foam supply and proportioning system to be used.
- Provide a statement on design goals and methodology for foam waste containment and disposal.
- Include calculations for the foam concentrate quantities required for the project.

Gaseous Fire Extinguishing Systems

- Provide calculations verifying agent quantity, number of required tanks and intended tank location.
- When systems are installed in existing facilities, ensure a structural analysis is provided for the intended tank location as required.

Fire Alarm/Detection/Reporting Systems

- Provide statements identifying the type of interior system and accompanying base reporting system to be provided.
- Provide a complete description of the sequence of operations.
- Larger projects should consider using addressable fire alarm systems. The A&E is encouraged to consult with the LANTDIV Fire Protection Engineering Branch to properly decide when such a system should be used.
- State specific requirements needed for the fire alarm system to meet all ADA criteria.

Modifications to Existing Systems

- Provide a complete description of the existing fire alarm system. Indicate make and model of the fire alarm panel. The number and descriptions of all existing zones and clearly cover the expansion capabilities of the system. Age and condition of the system should also be addressed.
- Verify that the existing fire alarm panel is still in current production. Specify replacement of existing system if parts are no longer available.

- Provide a power supply analysis. Determine power supply and standby battery capacity requirements of existing system and new devices. Ensure the power supply is capable of supporting the electrical load of the new devices.
- Provide a complete circuit analysis. Ensure that the existing panel has the initiating and signaling expansion capabilities.
- If the existing system is to be replaced, reuse of existing conduit runs is acceptable. However, all existing conductors shall be replaced with new conductors.

• Fire Protection Drawings

The following identifies some of the minimum information required on the contract drawings. “*” items are required, as a minimum, for the 35% submittal. All noted items are required, as a minimum, for the pre-final and final submittals.

Civil

- *Identify exterior distribution piping and sizes.
- *Identify all fire hydrant locations and provide a fire hydrant detail. Locate fire hydrants so all parts of the building are within a 350-foot hose lay from a hydrant. Locate a hydrant within 150 feet of a sprinkler system fire department connection.
- *Provide a detail of the fire main service entrance to the building. Identify a pipe sleeve in the floor slab.
- *Identify the PIV location and provide a detail.
- *Provide fire department vehicular access in accordance with NFPA 1141, “Fire Protection in Planned Building Groups”.

Structural

- Clearly delineate location and extent of all required fireproofing (Coordination with architectural sheets is required).

Architectural

- Identify location of fire rated partitions.
- Provide details for each fire rated partition, floor, and roof deck assembly. Provide associated UL design numbers for each detailed assembly.
- Refer to Chapter 6 of NFPA 101 and Appendix E of NFPA 80 for required ratings of openings and corresponding classifications. Identify the letter classification and associated hourly rating of all fire doors in the door schedule.
- Provide details of sub-floor plenum dividers or rated partitions for computer or electronic facilities. Plenum dividers are required when different and adjacent sub-floor areas are protected with independent extinguishing systems.
- Identify the location of required fire extinguisher cabinets and mounting brackets. Provide a typical cabinet detail.
- Provide a detail of any recessed fire extinguisher cabinet in a fire rated partition.
- Identify the location of smoke/heat detectors, exit signs and emergency lights on the reflected ceiling plans. Ensure coordination with the respective electrical sheets.
- Identify non-typical firestopping penetrations, curtain walls, seismic joints and expansion joints.

Plumbing/Mechanical

- Identify location of fire dampers. Fire dampers in ducts penetrating one hour rated partitions are not required where the duct is metallic, has an external cross sectional area of 100 square inches or less and runs continuously through the partition. Identify the associated UL firestop System Number (Series WL7000). Ensure ceiling mounted supply diffusers/return grills have fire dampers where installed in a rated ceiling assembly. Refer to NFPA 90A for additional assistance.

- Provide fire damper details for wall and floor penetrations.
- Identify location of duct smoke detectors in AHU elevation/detail and in control schematics. Detectors shall be 24V, powered and electrically supervised by the building fire alarm panel, and furnished under the fire alarm specification (Section 13852). The duct smoke detectors will be installed under the appropriate mechanical division 15 sections. Provide access doors at all fire damper locations.
- Drains for sprinkler systems and fire pumps shall discharge to a safe location at the exterior. Discharge to floor drains shall only be permitted as a last resort. When provided, ensure floor drains are sized to accommodate the anticipated flow. Recall that maintenance testing of sprinkler systems requires a 2-inch main drain test under full system pressure. Minimum floor drainpipe size shall be 6 inches. Utilize a long turn elbow where the pipe changes from the vertical to the horizontal. Frequently, drains are undersized and backup.

Fire Protection

Provide separate fire protection sheets for **all** projects. Identify all aspects of fire protection on these sheets, i.e., rated partitions*, sprinkler systems, fire alarm systems, pertinent life safety and building code backup data in table form*, associated details and riser diagrams. Do not use drawings for other disciplines to show fire protection systems.

Fire Alarm Systems

- *Show location of the FACP, radio transmitter or master box, all initiating and signaling devices (including duct smoke detectors), fire pump controller, electromagnetic door holders, single station smoke detectors, fire protection releasing panels, fire system air compressors, jockey pump controllers, etc.
- Fire Alarm zoning: Zone per wing/floor manual stations, corridor smoke detectors, sprinkler pressure/flow switches, valve tamper switches, duct smoke detectors, fire pump supervision (includes pump running, phase reversal, loss of phase, etc.)
- Transmit to the base receiving location specific zones for complex or large projects, i.e., CO₂ systems, zones per floor, etc.
- Provide surge arrestors for all fire alarm panels and radio transmitters.
- Provide a riser diagram showing hierarchy, arrangement and zoning of the system. Identify all typical circuits, interconnections and interlocks necessary for associated controls. It is not necessary to identify every field device individually, such as smoke and heat detectors if the devices are clearly shown on the floor plans.
- Provide a supporting fire alarm system operation and controls matrix.

Sprinkler Systems

- *Show locations of sprinkler risers, exterior water flow alarms, fire department connections, post indicator valves, and back flow preventers. Show the location of all isolation control valves. Do not show sprinkler branch lines or feed main piping, unless a specific routing is required (i.e., single feed to computer room or elevator equipment room and hoistway).
- Do not indicate the sizes of aboveground sprinkler pipe. Only indicate underground piping sizes. Allow the contractor to size the system based on their design.
- If a fire pump is required, show the location of the pump and all associated piping and required valves; the jockey pump, and the respective controllers. If a diesel pump is used, show the location of the fuel tank, muffler to the exterior, exterior wall penetration locations for the tank fill, vent and exhaust.
- Provide a complete layout of the pump room showing all equipment and piping to scale.

Gaseous Fire Extinguishing Systems

- Show the location of storage cylinders, sub-floor smoke detectors, releasing devices, main/reserve transfer switches, audio/visual devices and control devices such as

- dampers, shunt trip breakers for computer equipment shutdown, and air conditioning units to be shutdown, and electromagnetic door hold-open devices if provided.
- Identify the sequence of operations for release and notification.
- Provide a releasing system riser diagram. Identify all zones, circuit inputs and outputs necessary for system control.
- Provide a Controls Matrix.

AFFF Foam Systems

- Contact the LANTDIV Fire Protection Office for new criteria information regarding protection of aircraft hangars.
- Provide a complete layout of the pump room showing location of fire and foam pumps, concentrate storage tanks, and all associated equipment drawn to scale.
- Provide an AFFF riser diagram showing foam proportion method, test line connection, and all associated valves.
- Provide an AFFF monitor system.
- Show locations of all risers, monitors, manual releases, optical flame detectors, control panel, pumps, concentrate tanks, test connections.
- Identify the sequence of operations for foam release.
- Provide a releasing system riser diagram. Identify all zones, circuit input and outputs necessary for system control.
- Provide a Controls Matrix.

Electrical

The following minimum information shall be shown. Ensure coordination with the fire protection sheets.

- *Location of fire alarm and suppression system devices requiring 120V power supply or greater (i.e., fire alarm control panel, fire suppression control panel, fire suppression air compressor, fire pump and jockey pump controllers).
- Power connections for the fire pumps shall be in strict compliance with NFPA 20.
- Identify the location of all exit signs and emergency lighting fixtures. Provide the necessary details for each typical device.
- Identify the location and boundary limits of all "hazardous areas" as defined by NFPA 70.

Specifications

- The guide specifications are just that, "Guides". Edit the specifications appropriately and as needed for the specific project. However, design performance and criteria shall not be less than that identified in the guide specifications unless otherwise directed herein. Do not hesitate to call the LANTDIV Fire Protection Engineering Office if there is a question about the design or any LANTDIV or NAVFAC requirement.
- The project specifications shall be prepared utilizing the "SPECSINTACT" software system, which can be found on the "Construction Criteria Base" (CCB). Note the emphasis on the requirement to use the "SPECSINTACT" system. Merely subscribing to the CCB and then developing specifications by any other method, other than "SPECSINTACT" will not be acceptable. For additional information on LANTDIV Guide Specs & SPECSINTACT, see the LANTDIV Spec page (http://www.lantdiv.navy.mil/pls/lantdiv/url/page/CI4_ENGINEERING_AND_D_ESIGN Click on Guidance and Policy Tab.)
- Ensure the most current editions of the referenced publications are identified.

Typical Fire Protection Design Conflicts

- Division 01 (Submittals). Ensure the submittal register is properly edited with respect to review of the fire alarm and fire protection system submittals.
- Division 02 (Exterior Water Distribution Systems). Coordinate with sprinkler specifications in Division 13 with respect to underground piping, post indicating valves, backflow prevention, valve pits, etc. These items are typically referenced in both locations. Sprinkler sections should only specify underground materials from the building up to 5 feet beyond the building.
- The fire alarm control panel should not power door holders. They must be 110V powered by a local source. Actuation of the fire alarm panel will open relays to discontinue power to the door holders.
- Identification of fire rated doors in the door legend shall be properly coordinated with the correct label identification as stipulated in Appendix E of NFPA 80.
- Required UL design numbers for fire rated partitions are typically not provided.
- Close attention must be given to vertical shafts/chases for HVAC and plumbing systems with respect to NFPA 90A requirements and constructibility. NAVFAC has experienced reoccurring problems in multi-story barracks projects.
- Do not reference compliance with military handbooks or design manuals on drawings or in specifications.
- The UL, FM, and NFPA references in paragraph 1.1 of the guide specifications typically do not reference the current publication.
- Proper coordination of the Division 14 elevator specification with the appropriate fire protection requirements of the sprinkler sections (Division 13).
- Coordination of shutdown requirements for special fire extinguishing systems (i.e., shutdown of electronic equipment and room air conditioners upon activation of a CO₂ system).

• **Post Design Services**

- The LANTDIV Fire Protection Engineering Branch will perform construction shop drawing reviews, respond to fire protection related field RFIs, and witness final acceptance testing of fire protection systems.

• **Design Submittals**

• **35% Design Development Submittal**

• **Basis of Design**

Complete Basis of Design meeting the requirements as outlined throughout this guide.

• **Drawings**

Provide, as a minimum, all the “*” items noted in the Fire Protection Drawings section of this technical guide.

- **Calculations**
Submit all hydraulic calculations supporting all fire suppression systems for the project.
- **Guide Specifications**
Provide an outline list of the required fire protection specifications supporting the project.
- **100% Prefinal Submittal**
 - **Basis of Design**
Complete final Basis of Design meeting the requirements as outlined throughout this guide.
 - **Drawings**
Provide, as a minimum, all drawings as shown in the Fire Protection Drawing section of this technical guide.
 - **Calculations**
Submit complete final calculations supporting all the fire suppression systems for the project.
 - **Specifications**
Provide full edited fire protection specifications supporting the project.
- **Final Submittal**
 - **Drawings**
Provide all drawings required to meet the intended design approaches for the project. As a minimum, all noted drawings in the Fire protection Drawing section of this technical guide shall be provided.
 - **Specifications**
Submit completed final fire protection specifications supporting the project.
- **Overseas Requirements**
 - Host Nation Life Safety and Building Code analysis.
 - Comparisons with NFPA Codes

• References and Links

- Factory Mutual Global (FM)
(<http://www.fmglobal.com>)
- International Conference of Building Officials,
publishers of the Uniform Building Code (UBC),
(<http://www.icbo.org>)
- National Fire Protection Association (NFPA)
(<http://www.nfpa.org>)
- National Institute of Building Sciences (NIBS),
producer of the "Construction Criteria Base" (CCB).
(<http://www.nibs.org>); (<http://www.ccb.org/html/home.html>)
- Occupational Safety & Health Administration (OSHA)
(<http://www.osha.gov/comp-links.html>)
- Society of Fire Protection Engineers, Inc. (SFPE)
(<http://www.sfpe.org>)
- Underwriters Laboratories Inc. (UL)
(<http://www.ul.com/welcome.html>)
*** UL is not affiliated with ATLANTIC DIVISION, NAVAL FACILITIES
ENGINEERING COMMAND and does not endorse this Web site*

Preliminary Hydraulic Analysis Worksheet

Refer to [MIL-HDBK-1008](#)

1. Water Quantity:

- a. **Density * Design Area * 130%** = _____ gpm.
(Increase the area by 30% for dry-pipe systems and dual-action type preaction systems.)
- b. **Outside Hose Stream Demand** = _____ gpm.
- c. **Other** = _____ gpm.
(Includes water supply for in-rack sprinklers inside hose streams, oscillating nozzles, or other special interior systems.)
- d. **Domestic Demand** = _____ gpm.
- Total Water Demand** (a+b+c+d) = _____ gpm.

2. Water Pressure:

- a. **End-Head-Pressure** = _____ psi.
[density * (area/head)/k-factor]**2
Minimum 7 psi. K-factor is 5.6 for a 0.5 inch Orifice, 8.1 for a 0.53 inch orifice, and 11 for A 0.64 inch orifice.
- b. **Elevation Loss** = height * 0.433 = _____ psi
- c. **Outside Friction Loss** = _____ psi.
(include a reduced pressure backflow preventer for foam systems or a double check valve assembly backflow preventer for all other types of systems.)
- d. **Inside Friction Loss** = _____ 20 psi.
- Total Pressure** (a+b+c+d) = _____ psi.

The pressure required for special interior systems (i.e., in-rack sprinklers, oscillating nozzles) must be taken into account.

3. **Water Demand:** The quantity and pressure must be within the limits shown by the water supply data. Provide a water supply graph showing the supply and the calculated demand of the system. LANTDIV is not asking the designer to upgrade the activity water supply, but to show that the system being specified and designed can be installed with the supply available. This data is needed at the 35% design stage so corrective action can be taken to improve the water supply or change the scope of the project.

Attachment A